REMARKS

Claims 1-14, 16, 17, and 19-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koike, U.S. Patent 6,620,643. Applicants respectfully traverse the rejection.

The Examiner states "[a]lthough[] Koike does not explicitly state the active region has a total thickness less than or equal to about 0.25 of the wavelength and that a portion of the active region is located between 0.6 and 0.75 of the wavelength from the reflective surface, it would have been obvious to one of ordinary skill in the art to make the arrangement regarding the distance of the reflective surface from the active region, since discovering an optimum value of a result effective variable involves only routine skill in the art." See office action, pages 2 and 3. Applicants respectfully disagree.

MPEP 2144.05 II, requirement for a prima facie case of obviousness using ranges

MPEP section 2144.05 discusses obviousness of ranges in claims. In general, where the claimed ranges overlap or lie inside ranges disclosed by the prior art, a *prima facie* case of obviousness exists. Section II of 2144.05 deals with optimization of ranges. The title of section A of section II is "Optimization Within Prior Art Conditions or Through Routine Experimentation" and thus notes two cases where a range in a claim is prima facie obvious: (1) where the claimed range is within or overlaps a prior art range, and (2) where the range could be determined by routine experimentation. Applicants respectfully submit that neither case applies to the present claims.

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The claimed range does NOT overlap with the ranges in Koike

The first case of MPEP 2144.05 II does not apply because the ranges in independent claims 1, 19, and 26 do not overlap with the distance between the active layer and reflecting layer taught in Koike.

Claim 1 recites "a portion of the active region is located between $0.6\lambda_n$ and $0.75\lambda_n$ from the reflective surface." The Examiner cites Koike's active layer 160 as being claim 1's active region and Koike's light reflecting metal layer 150 as being claim 1's reflective surface. Disposed between these two layers in Koike's Fig. 1 device are sapphire substrate 101, AlN buffer layer 102, n-type contact layer 103, non-doped InGaN intermediate layer 104, and n-type GaN cladding layer 105. According to column 4, lines 43-53, layer 102 has a thickness of 200 Å, layer 103 has a thickness of 4.0 μm, layer 104 has a thickness of 2000 Å, and layer 105 has a thickness of 250 Å, for a total thickness of 4,245 nm, omitting substrate 101, which is expected to be the thickest layer in the device, as it provides mechanical support for the semiconductor and metal layers formed over it. At column 4, line 11, Koike teaches that its devices emit bluish purple to blue light having wavelengths between 380 and 485 nm. A person of skill in the art would understand that if the device emits bluish purple to blue light, the wavelengths 380 to 485 nm are the wavelengths of light in air.

The wavelength λ_n in claim 1 is defined in paragraph [0035] of the present application of the wavelength in air divided by the index of refraction of the semiconductor material in the device, n = 2.4 for GaN. Accordingly, the range in claim 1 is between $0.6\lambda/n$ and $0.75\lambda/n$. Substituting n = 2.4 for both terms, λ = 380 nm for the first term, and λ = 485 nm for the second term, for a device emitting light between 380 and 485 nm, as in Koike's device, the distance between a portion of the active region and the reflective surface according to claim 1 may be between 95 nm and 152 nm. In contrast, as described above, in Koike's device, the distance between active layer 160 and light reflecting metal layer 150 is at least 4245 nm.

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The Examiner is reminded that the thickness of 4245 nm omits the thickness of substrate 101, which is expected to be the thickest layer of all. As such, the range claimed in claim 1 does not overlap with the thickness taught by Koike, since the range claimed in claim 1 is orders of magnitude smaller than the thickness taught by Koike. A similar analysis may be applied to determine that the ranges claimed in claims 19 and 26 also do not overlap with the thickness taught by Koike.

Accordingly, Koike does not present a prima facie case of obviousness of claims 1, 19, and 26 based on overlapping ranges.

Koike does not teach that the claimed range is a result-effective variable

The second case of a prima facie case of obviousness as described MPEP 2144.05 II, that is, that the range could be determined by routine experimentation, does not apply because Koike does not teach that the range in claim 1 is a result-effective variable, defined by 2144.05 II B as "a variable which achieves a recognized result." 2144.05 II B teaches that a "particular parameter must first be recognized as a result-effective variable . . . before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." (Underlining added.) In support of this position, 2144.05 II B cites *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). 2144.05 II B summarizes the Antonic case as follows: "The claimed wastewater treatment device had a tank volume to contractor area of 0.12 gal./sq. ft. The prior art did not recognize that treatment capacity is a function of the tank volume to contractor ratio, and therefore the parameter optimized was not recognized in the art to be a result-effective variable."

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Applicants have not found, and the Examiner has not cited, any teaching in Koike that recognizes that the location of the active region relative to a reflective surface is a result-effective variable. Actually, Applicants cannot find any teaching in Koike attributing any

significance at all to the location of the active region. Since Koike does not teach that this is a result-effective variable, determining its optimum range cannot be considered routine experimentation.

Accordingly, Koike does not present a prima facie case of obviousness of claims 1, 19, and 26 based on routine experimentation to optimize a recognized result-effective variable.

Since neither of the two cases of prima facie obviousness set forth in MPEP 2144.05 II apply, Applicants respectfully submit that the Examiner has failed to make a prima facie case of obviousness for claims 1, 19, 26 and their dependent claims.

Figure 4 demonstrates criticality of the claimed ranges

Even if Applicants assume, for the sake of argument, that the Examiner has made a prima facie case of obviousness, Applicants' own disclosure refutes that case. MPEP section 2144.05 III states "Applicants can rebut a prima facie case of obviousness based on overlapping ranges by showing the criticality of the claimed range . . . In such a situation, the application must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." Applicants respectfully submit that Fig. 4 and accompanying text (for example, paragraphs [0041], [0042], and [0043]) demonstrate that the claimed ranges are critical, as they result in an extraction efficiency that is superior to other ranges. Accordingly, even if the Examiner disagrees with the above demonstration that Koike does not provide a prima facie case of obviousness, Applicants' Fig. 4 rebuts the claim of obviousness by demonstrating unexpected results from the claimed ranges.

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It is physically impossible to modify Koike to result in the claimed ranges

As described above, in the device described by Koike, the active layer is located at least 4245 nm from the light-reflecting metal layer. In order to locate the active layer between $0.6\lambda_n$ and $0.75\lambda_n$ from the reflective surface, as claimed in claim 1, substrate 101 would likely have to be removed and the thickness of layers 102, 103, 104, and 105 would likely have to be significantly reduced. In the device of Koike's Fig. 1, substrate 101 clearly provides mechanical support to the layers formed on the substrate. Without substrate 101, a person of skill in the art would expect the device of Koike's Fig. 1 to disintegrate. In addition, n-type contact layer 103 must have a minimum thickness in order to spread current from electrode 140 to the area under active layer 160. If n-type contact layer 103 were thinned to locate the active layer between $0.6\lambda_n$ and $0.75\lambda_n$ from the reflective surface, a personal of skill in the art would expect that the amount of current spreading would be significantly diminished, possibly to the point where the device would not emit light at all. Accordingly, Applicants respectfully submit that it is physically impossibly to modify Koike according to claim 1, and Koike thus cannot render claim 1 obvious. A similar analysis may be applied to the ranges claimed in claims 19 and 26.

Conclusion

For the above reasons, Applicants respectfully submit that the Examiner has not made a prima facie case of obviousness for claims 1, 19, and 26. Even if the Examiner has made a prima facie case of obviousness, Fig. 4 and accompanying text rebut the claim of obviousness by demonstrating the criticality of the ranges claimed in claims 1, 19, and 26. Further, it cannot be obvious to modify the device of Koike to result in the devices claimed in claims 1, 19, and 26, because such a modification is physically impossible. Claims 1, 19, and 26 are therefore allowable over Koike.

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Dependent claims

Claims 2-18 depend from claim 1. Claims 20-25 depend from claim 19. These claims are allowable over Koike for at least the same reasons as the independent claims from which they depend. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koike in view of Japanese reference 05190901. The Japanese reference is cited only as teaching a lens and as such adds nothing to the deficiencies of Koike with respect to claim 1. Claim 15 is thus allowable over the combination. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koike in view of U.S. Patent 6,753,214 to Brinkmann et al. Brinkmann et al. is cited only as teaching a distributed Bragg reflector and as such adds nothing to the deficiencies of Koike with respect to claim 1. Claim 18 is thus allowable over the combination.

In view of the above arguments, Applicants respectfully request allowance of claims 1-26. Should the Examiner have any questions, the Examiner is invited to call the undersigned at (408) 382-0480.

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